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## MUSCADINE GRAPES.

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### INTRODUCTION.

The Muscadine grapes are native to and thrive in soil and under conditions suited to them throughout the entire southeastern Coastal Plain, from the James River to Florida, reaching well up into the Blue Ridge Mountains, and from Florida along the Gulf coast to Texas, and also northward along the Mississippi River to southeastern Missouri and the Tennessee River. (Fig. 1.) There are at least 250,000,000 acres of land in this territory which are well adapted to the culture of these grapes, a large percentage of it being at present untilled.

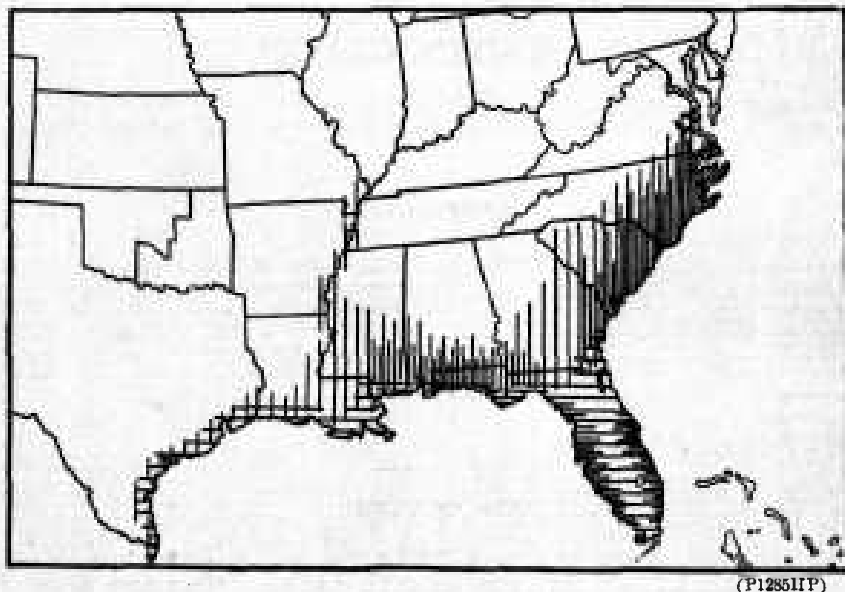
While the Muscadines have been more extensively grown than other grapes in much of this territory for some time, it is only during the last decade that their production has assumed real commercial importance.

### BOTANICAL RELATION AND CLASSIFICATION.

The Muscadine grapes, which include two botanical species (*Rundifolia* and *Munsoniana*), make up one of the groups of the genus *Vitis*.

The Muscadines are sometimes called "berry" grapes, because of a tendency of the individual berries in most varieties to shell off from the cluster as soon as ripe, instead of adhering as do the Euvitis (often called "bunch") grapes.

The Muscadines have hard wood, varying in color from ashy gray to grayish brown, or sometimes yellowish brown. While the bark adheres closely on the young branches and is never shreddy, it sheds annually on the older wood, especially on the trunks of vigorous-growing vines. The trunks have a tendency to split into several parts as the vines grow old (fig. 2), although very old vines often



(P1285HP)

FIG. 1.—Sketch map of the southeastern portion of the United States, showing the natural distribution of Muscadine grapes. The vertical lines show the region where the *Rotundifolia* varieties grow and the horizontal lines the growing region of the *Munsoniana* varieties.

have solid, treelike trunks. Several trunks may develop if a vine is not trained when young. In the young canes the pith is continuous through the nodes. The young wood is covered with numerous small, prominent, warty lenticels. The growing shoots are yellowish or reddish at the tip when young, are short jointed, angled, or sometimes flattened, and have intermittent relatively long, tough, strong, unforked single tendrils of the same color as the twig to which they belong. The tendrils, when permitted to do so, may girdle even large branches. The leaves (figs. 3 and 4) are below medium size; smooth and shiny above and underneath; more or less round to broadly cordate, with a wide, rather shallow basal sinus; generally not lobed, though sometimes slightly three-lobed; and a prominently toothed margin.

The clusters are more or less roundish, ranging from loose to compact, and are relatively small, varying from 1 to 40, but generally of 4 to 10 berries. The berries are round and vary from very small to very large. They are green, pearly, bronze, red, or black in color, and are generally more or less speckled with reddish or russet dots. The skin is relatively thick; the pulp varies from meaty to melting and juicy; the seeds (fig. 5) are 2 to 4 in number (occasionally 5 or 6), and vary with the variety from small to very large. They are flattened, shallow, broad, notched, with very short pointed beak, and narrow raphe and chalazae, surrounded by radiating wrinkles. The leafing, flowering, and fruiting periods are late. In almost all fruiting varieties the pollen is practically sterile or entirely so. (Figs. 6 and 7.)

Of the two *Muscadinia* species, *Vitis rotundifolia* is the more important, as all the prominent varieties belong to it and the species is native in practically the entire territory of the group.

*Vitis munsoniana*, on the other hand, is more like a subtropical variation of *Vitis rotundifolia* and is native only in Florida, the borders of the Gulf of Mexico, and possibly near the southeastern Georgia coast. *Vitis rotundifolia* (fig. 6) bears small clusters of large berries with large seed, while *Vitis munsoniana* (fig. 7) bears relatively large clusters of small berries (8 to 30) with small seed. *Munsoniana* vines are slender, more trailing, and do not climb as high as *Vitis rotundifolia*. Their leaves are generally smaller, with narrower basal sinuses and less numerous but more prominent marginal teeth. *Munsoniana* also has the ever-bearing habit, and in August buds, blooms, and fruit in all stages of development may be found on the vines at the same time.



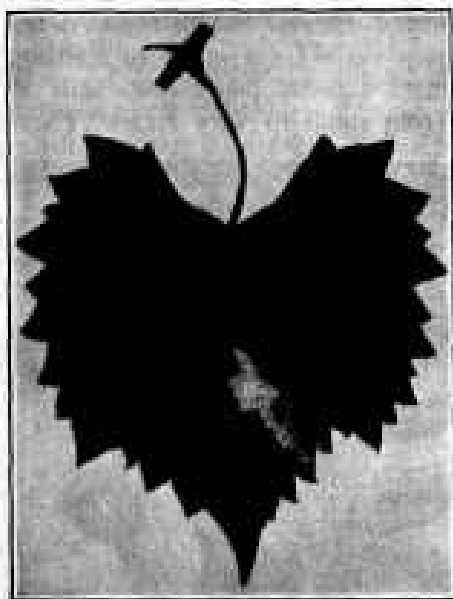
FIG. 2.—Trunk of an old *Rotundifolia* vine. (P2313HP)

## PROPAGATION.

Muscadine grapes may be propagated from seed or by layers, cuttings, or grafts.<sup>1</sup>

## SEEDS.

Muscadine grapes should be



(P7819HP)

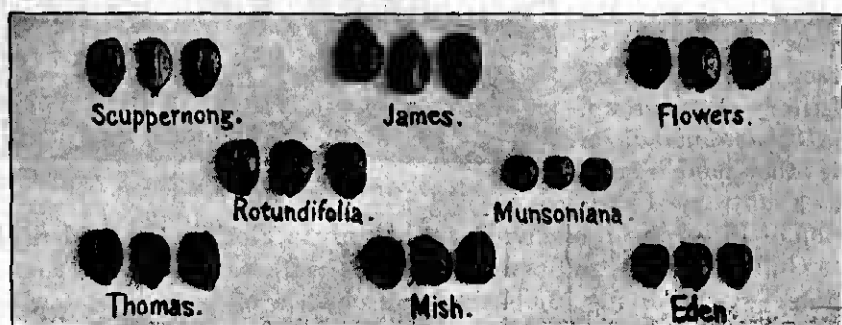
FIG. 3.—A Scuppernong leaf. (Two-thirds natural size.)



(P7823HP)

FIG. 4.—An Eden leaf. (Two-thirds natural size.)

grown from seed only when it is desired to produce new varieties. This is work for those interested in plant breeding.



(P7654HP)

FIG. 5.—Typical Rotundifolia and Munsoniana seeds.

## CUTTINGS.

The United States Department of Agriculture has for several years been experimenting in propagating Muscadine grapes from cuttings

<sup>1</sup> For a description of methods of propagation, see the following publications:

Husmann, G. C. Grape propagation, pruning, and training. U. S. Dept. Agr., Farmers' Bul. 471, 29 p., 30 fig. 1911.

— and Dearing, Charles. The Muscadine grapes. U. S. Dept. Agr., Bur. Plant Indus. Bul. 273, 64 fig., 26 g., 11 pl. (1 col.). 1913.

(fig. 8), but so far no altogether satisfactory method has been found. The best results have been obtained by using long cuttings (15 inches) of short-jointed, medium-sized, well-ripened wood, cut in the early winter and stored in a callusing mound until about April 1, and then planted slanting in well-prepared ground, leaving only 1 or 2 inches projecting above the ground.

Considerable difference has been found to exist in the relative rooting qualities of the different varieties. Some of the staminate



(P6506HIP)

FIG. 6.—Fruit and branches of *Vitis rotundifolia*. (About one-half natural size.)

Muscadines root with relative ease. Of the commercial varieties, the Thomas and Flowers give the best results, the James being intermediate, and the Eden and Scuppernong rooting with the greatest difficulty. The best results with the Scuppernong were 4 per cent, while with the Thomas as high as 48 per cent of the cuttings have rooted. Vines grown from cuttings are, however, much better

than those from layers, and it is probable that when more information has been obtained on the subject it will be found desirable to propagate at least some of the varieties from cuttings.

One means of furthering the rooting of cuttings is to graft a small piece of root on the end of the cuttings and then treat such grafts as if they were cuttings. In this manner in a normal season 86 per cent of the Thomas and 20 per cent of the Scuppernong cuttings were rooted.

#### LAYERING.

Layering is the most common method practiced by grape growers and nurserymen in propagating Muscadine grapes. (Fig. 9.) By



(P18344HP)

FIG. 7.—Fruit and branches of *Vitis munsoniana*. (About one-half natural size.)

this method the greatest number of plants are produced at the least expense. Such plants are, however, often poorly shaped and difficult to handle. Canes may be layered at any season of the year, but most frequently in midsummer, when canes of the same season's growth are used. These are bent down to the ground and covered with earth, the growing tips being allowed to project above the soil. Roots will form by autumn and the layers can then be cut from the parent vines and divided, the laterals which were left usually

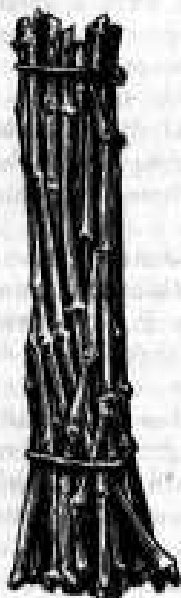
forming the tops of the new plants. After being divided, the plants should be thoroughly heeled in, like plants from seeds or cuttings. In general practice the layers are not disturbed until wanted for use in the spring.

Where vines are on overhead arbers, layers can be made by placing boxes of soil on the arbers and layering the canes into these boxes.

Nurserymen grow Muscadine vines especially for layering purposes, causing them to grow along the surface of the ground. Each season, in July (or in August in Florida), they cover the annual shoots with soil and cut away the rooted vines in winter, leaving the spurs which send forth new growth to be again layered the next season.

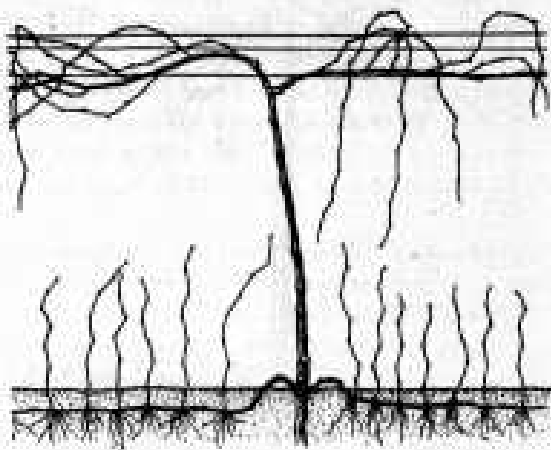
#### GRAFTING.

Grafting is seldom resorted to with Muscadine grapes, and those who have tried to graft them have



(P4671HP)

FIG. 8.—A bundle of grape cuttings.



(P6037HP)

FIG. 9.—Diagram of a grapevine with two canes layered, showing the method of propagation by layers.

not had flattering results. For that reason grafting is not described in this bulletin.<sup>1</sup> Some of the advantages of grafting in vineyard practice are: (1) New varieties may be rapidly brought into bearing by grafting on older, healthy, strong vines; (2) worthless vines may be changed into valuable ones by grafting them with such; (3) varieties which will not grow readily from cuttings can generally be easily grafted.

#### SOILS.

Muscadine grapes can be grown on almost any of the tillable soils of their natural habitat, but not with equal success; for example, they do not thrive in low, wet soil or on barren, clay hills. Generally

<sup>1</sup> For information on vine grafting, see Husmann, G. C., op. cit.

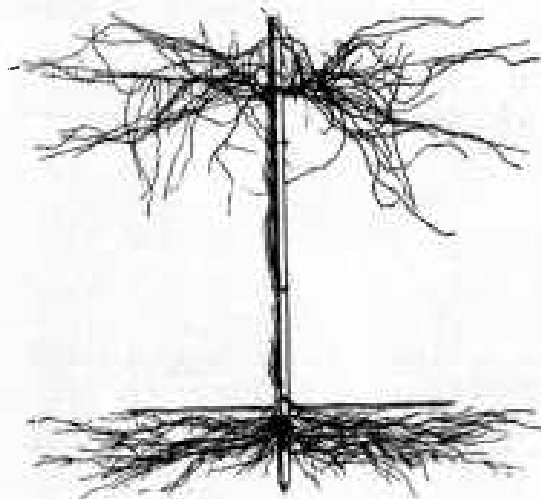


speaking, the best results with Muscadine grapes are obtained on sandy loam soils that are well drained and contain a fair amount of fertility and organic matter. Such soils abound throughout the southeastern Coastal Plain. Muscadine grapes also grow successfully in the better red-clay soils of the Piedmont section. It might also be said that these grapes thrive where cotton thrives and that any well-drained land in the tidewater section where hardwood as well as pine trees grow is good Muscadine grape land.

As the Muscadines have a shallow, near-the-surface, spreading root system (fig. 10), deep surface soils, though preferable, are not absolutely necessary. It is important, however, to have a good, well-drained subsoil. If hardpan clay is encountered near the surface it should be broken up with a subsoiling plow or, if neces-

sary, with sufficient charges of dynamite to break through it at the places where vines are to be set.

When once established, Muscadine vines will grow in fairly wet ground, though not so well as on better drained land; neither will the fruit be of as good quality; for which reasons wet soils are not recommended. Furthermore, it is practically impossible to get a stand of vines in such soil unless the rows



(PI201HP)

FIG. 10.—A Muscadine vine, showing its characteristic shallow, spreading root system.

where the vines are to be planted are temporarily drained by plowing a furrow away from them on either side, leaving the rows as narrow strips of land not more than 2 feet wide. After the plants have become established the furrows are closed by cross cultivation.

If the grapes are to be planted on new land it is best previously to grow a crop of tobacco, corn, cotton, or some other annual crop requiring cultivation and, if possible, a leguminous crop, such as cowpeas. This will get the ground in ideal condition for planting vines.

Muscadines grow vigorously when once established, but they have difficulty in starting, and a large percentage of the plants in new plantings will be lost if the soil is either too wet or too dry, or otherwise not in good condition for planting.

## PLANTING.

How grapevines should be planted has been frequently discussed in department publications.<sup>1</sup> Muscadines are planted in much the same way as other grapevines. The best time to plant is in early spring.

The ground should, of course, be well prepared. Either 1 or 2 year old vines are suitable for planting, but strong 1-year-old plants are usually preferred.

Figure 11 represents plants of Muscadine grapes as they are received from the nursery. They should not be planted in a permanent location in this condition, but should be pruned before planting, as shown in figure 12. On 1-year-old plants the top should be shortened to the required length, and where the plants are more than 1 year old the top should be cut back to a single spur.

The hole in which the plant is to be set should be made wide enough to prevent crowding the roots and so deep that when the vine is planted only the top will be slightly above the ground. After the hole has been dug, a little good pulverized surface soil should be thrown into the bottom and the vine placed in position. Pulverized surface soil is then thrown in, worked between the roots of the plant, and the whole mass of soil firmed as the hole is filled.

It is very important that the roots of the vines be kept moist at all times during planting.

Efforts should be made to establish the roots as deep as possible in the soil, so as to make the vines more drought resistant and to prevent injury from future cultivation. This result is furthered by planting the vines as deep as the plowing and preparation given the soil will reasonably permit and after the vines are planted giving the soil deep and regular cultivation.

The distance apart that Muscadine grapes should be planted depends on the variety and the training system. The James and Flowers grapes can be grown closer together than vigorous varieties like the Thomas, Scuppernong, and Eden. More vines per acre can be grown successfully on the vertical than on the horizontal system. The relative advantages of these systems will be discussed later. Vines grown on the overhead-arbor trellis are usually planted 20 by 20 feet. It is the opinion, however, of those who have given the matter closest attention that it is much better to plant the vines about 10 by 10 or 12 by 12 feet apart and then thin out as they begin to crowd. In this manner much heavier yields per acre may be obtained from the first three or four barvests, and vineyard space is not wasted.

<sup>1</sup> Husmann, O. C. Grape propagation, pruning, and training. U. S. Dept. Agr., Farmers' Bul. 471, 29 p., 30 fig. 1911.

— and Dearing, Charles. The Muscadine grapes. U. S. Dept. Agr., Bur. Plant Indus. Bul. 273, 64 p., 26 fig., 11 pl. (1 col.). 1913.

The accompanying diagram (fig. 13), suggested by Mr. R. C. Cool, of North Carolina, illustrates a good method of planting for overhead training when the vines are set close with the intention of thinning them as they grow larger. By this plan the vines are set 10 by 10 feet apart. The location of the permanent vines (20 feet apart each way) is indicated by *P*. The vines represented by *X* and *O* should

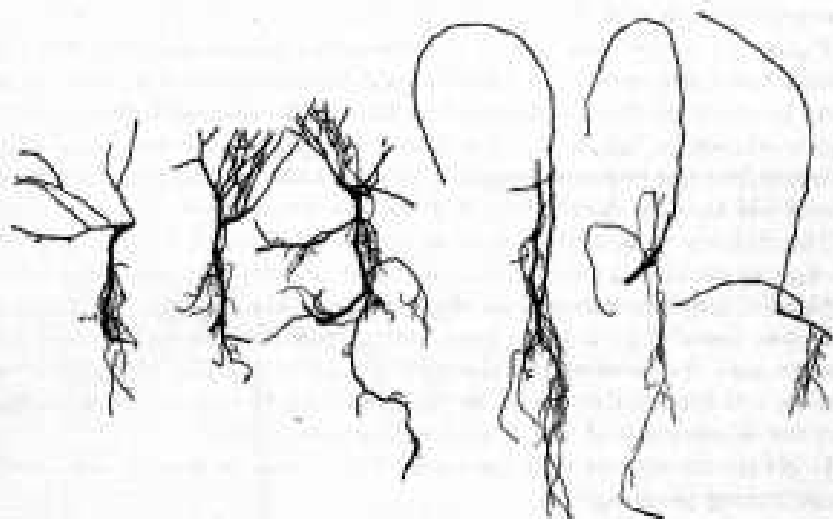


FIG. 11.—Rotundifolia vines as received for planting.

(P16832HP)

be removed as soon as they begin to crowd. The *O* vines can remain two or three years longer than the *X* vines.

When vines are grown on a vertical trellis, a good distance for the Scuppernong and the stronger growing sorts would likely be rows 10 feet apart and vines 10 feet apart in the rows, thinning out later, as the vines begin to crowd, to 20 feet apart in the row, as indicated

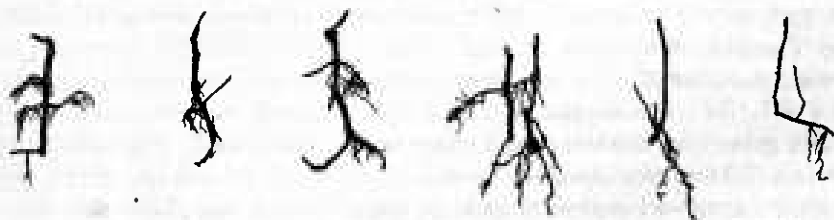


FIG. 12.—Rotundifolia vines pruned ready for planting.

(P16832HP)

in the following diagram (fig. 14), in which *P* represents the permanent vines and *T* the temporary ones.

For varieties not as strong growing, the distances could be reduced to rows 8 feet apart with the vines 8 feet apart in the rows, thinning later, as the vines begin to crowd, to 16 feet apart in the rows. During the first growing season the vines can be supported by a stake. The next season the trellis will be required.

## COMPANION CROPS.

During the first two seasons of a vineyard's life, companion crops should be grown in it, to build up the land and to furnish revenue to assist in meeting the expense of establishing the vines. After the vineyard has passed the third summer, the growing of companion crops should be viewed from the standpoint of their value in regulating the soil-moisture supply and fertility. In the first years of the vineyard, hoed crops, such as melons, tomatoes, peanuts, cotton, or tobacco, may be grown between the rows of vines. No corn and grain crops should be planted. Other leguminous crops, such as cowpeas and soy beans in the summer and vetch, bur clover, and crimson clover in the winter, may be grown for seed or for turning under the soil.

## CULTIVATION.

It is now generally believed that Muscadine vineyards should have systematic cultivation, though the advisability of deep culture has

P	X	P	X	P	X	P	X	P	X
X	O	X	O	X	O	X	O	X	O
P	X	P	X	P	X	P	X	P	X
X	O	X	O	X	O	X	O	X	O
P	X	P	X	P	X	P	X	P	X

FIG. 13.—Diagram showing a method employed in alternating permanent and temporary plantings of grapevines when set close for overhead training: P, Permanent; O and X, temporary.

P	T	P	T	P	T	P
T	P	T	P	T	P	T
P	T	P	T	P	T	P
T	P	T	P	T	P	T
P	T	P	T	P	T	P

FIG. 14.—Diagram showing a method employed in alternating permanent and temporary plantings of grapevines grown on a vertical trellis: P, Permanent; T, temporary.

been questioned. If cultivation is started at the beginning and properly practiced at all times, the roots of the vines will strike deeper and it is believed there will be no serious root injury from cultivation. Especially is this true in well-drained soils.

In discussing proper vineyard culture it is necessary to refer in more detail to the growing of cover crops or companion crops. Culture and intercropping go hand in hand. It has been stated that the soil should be put into the best cultural condition before planting. It should be cultivated deep and well. Throughout the first summer a space of at least 2 feet on all sides of the vines should be kept under clean culture or the vines should be mulched. The rest of the ground may be devoted to companion or cover crops. If vines are planted as close as 10 by 10 feet and the grower can see his way clear to do so, it is best to intercrop the vineyard, with a view to aiding the vines to do their best. In this case cowpeas are usually grown during the summer, and the land is seeded down to bur clover, crimson clover, or hairy vetch in the early autumn.

Bur clover and hairy vetch reseed themselves if allowed to ripen their seed before the ground is cultivated. Crimson clover must be seeded each fall, but it is probably the best of the winter cover crops to grow in the vineyard, because it allows the ground to be broken earlier in the spring. Bur clover will yield abundant crops of seed that sell at a good price, but it prevents spring cultivation until nearly the first of June in North Carolina and does not afford as good early spring grazing.

The second season the ground should be broken and thoroughly harrowed as soon as the winter cover crop will permit. A strip of ground next the vines should be kept under clean culture throughout the summer, but the rest of the ground can again be planted to cow-



(P12869HP)

Fig. 15.—*Rotundifolia* vines with a leguminous cover crop growing between the rows.

peas (fig. 15). The summer crop should be followed by a leguminous cover crop, such as bur clover or vetch, during the winter.

During the first two years, if desired, it is perfectly feasible to grow one or two rows of cotton, potatoes, melons, peanuts, tomatoes, tobacco, or other similar crops that require clean culture, in place of cowpeas (fig. 16). If such crops are planted they should receive proper applications of fertilizer just as if they were planted alone. It will not harm the vines, when properly supported, to graze cows, sheep, or hogs on the winter cover crop in the vineyard in early spring before the vine growth starts.

After the second season the usual vineyard practice is to grow winter cover crops, such as bur clover, crimson clover, or vetch, each winter and to turn these under in the spring as soon as possible after grazing, cutting for hay, or harvesting for seed. Then the vineyard should have a thorough plowing, followed by cultivation through

the early part of the summer. Cowpeas are planted about midsummer, and if the winter cover crop does not reseed itself it should be seeded down in the early autumn under the cowpoas.

In cultivating and intercropping the bearing vineyard the condition of the vines should suggest the treatment to be followed. The use of cowpeas and other leguminous crops is emphasized, because under most conditions it is desirable to encourage growth. It is possible, however, to make rich soils too rich and thus cause an overproduction of wood growth at the expense of fruit. If such a condition should arise the grower should abandon the leguminous crops, grow a row of cotton between the vines, and in the autumn seed down to oats or rye. Generally, however, an excessive wood growth can



FIG. 16.—*Rotundifolia* vines grown with an intercrop.

(P7891H1)

be checked by allowing the vines more fruit-bearing surface or stopping the application of nitrogenous commercial fertilizers.

In plowing a bearing vineyard the plow should be run shallow near the vines, but the ground can be plowed deep farther away from the vine trunks if done regularly. The ground should be kept level, and if the soil is thrown toward the vines at one cultivation it should be thrown away from them at the next cultivation.

#### FERTILIZATION.

In order to get the best results with Muscadine grapes commercial fertilizers are usually required, in addition to good cultivation and intercropping. Young vines, especially during the first year after planting, require principally nitrogenous fertilizers, such as nitrate of soda, dried blood, and cottonseed meal. It is a good practice to mulch young vines with manure, where it is available. The object

of giving young vines heavy applications of fertilizer is to induce a robust growth which will make a vine capable of bearing a profitable crop the third year. Under ordinary conditions such results would be attained not earlier than the fourth year. Bearing vines require more phosphoric acid and potash than do young vines and should have only enough nitrogen to keep them in vigorous condition. If the cultural and intercropping directions given here are followed but little nitrogen will generally have to be added as commercial fertilizer. More fertilizer is, of course, required on poor sandy soil than on heavier loamy or clay-loam soils.

In order to give an idea of the quantity of fertilizer usually applied it may be said that in experiments at the Muscadine Grape Experiment Vineyard, Willard, N. C., a mixture analyzing 6 per cent phosphoric acid, 6 per cent potash, and 4 per cent nitrogen, applied at the rate of 600 pounds to the acre, is being used as a normal application. An experienced grower of North Carolina states that a safe rule is to apply and work well into the soil in the spring 400 pounds of acid phosphate and 75 to 100 pounds of muriate of potash per acre, adding light applications of nitrate of soda if the vines need it.

A well-informed grower in 1914 used on a vineyard in sand-hill soil, where the vine growth was not vigorous, a fertilizer containing a great quantity of materials, so as to have the plant feed become available at different times during the season. Each ton of this mixture contained 106 pounds of nitrate of soda, 880 pounds of acid phosphate, 400 pounds of dried blood, 200 pounds of fish scrap, 208 pounds of sulphate of ammonia, and 206 pounds of muriate of potash. This fertilizer was assumed to contain 7 per cent of nitrogen,  $8\frac{1}{2}$  per cent of phosphoric acid, and 5 per cent of potash. It was used at the rate of 2 to 4 pounds per vine, depending on the size of the vine.

#### POLLINATION.

The pollination of Muscadine grapes has been studied very closely by various investigators. It has been determined that the varieties ordinarily grown are practically self-sterile, notwithstanding the fact that the blossoms have both pistils and recurved pollen-bearing stamens. In order to produce berries they must therefore be cross-pollinated with the fertile pollen of staminate Muscadine vines. The male, or staminate, vines of course produce no fruit. It is estimated that probably 75 per cent of the wild Muscadine grapevines are staminate. It has been pretty accurately established that the pollen is carried from the male to the pistillate, or female or fruiting, vines almost entirely by insects. In the past there has been a sufficient number of staminate vines and of insects to insure the proper cross-pollination of vines. Now, however, as the Muscadine grapes are being planted in large vineyards and as the number of wild male vines is being reduced through the clearing up of the land, it becomes

essential to fruit production to plant male vines here and there in the vineyards. No experiments have been attempted to determine the proportion of male vines needed, but the opinion is common that one staminate vine should be planted for every 8 or 10 fruiting vines. Applying this rule to the diagrams illustrating the manner of planting which were presented as figures 13 and 14, every third vine in every third row, be it permanent or temporary, should be a male vine. In the diagram for planting overhead vineyards (fig. 13) the male vines should not be placed at the points represented by *O*. It is important to use only vigorous, heavy-blooming male vines that bloom simultaneously with the fruiting vines. In large vineyards of 100 or more acres it is believed that it will be profitable to locate beehives here and there about the center of the vineyards. When wild insect visitors come to a large vineyard they apparently have no incentive to go into the center of it so long as there is abundant bloom around the edges to supply their needs. The investigations of the Department of Agriculture show that while only 7 to 10 per cent of the Muscadine buds normally produce ripe berries, 20 to 30 per cent will produce berries if properly pollinated. This is equivalent to an increased yield per acre of approximately 200 to 300 per cent.

#### PRUNING AND TRAINING.

The system of training followed in the growing of Muscadine grapes for commercial purposes has been and still is mostly on overhead arbors. These vary from the crudest supports under the scattering vines seen about so many southern homes to the latest overhead wire supports used in commercial plantings. These wire supports are practically identical in construction with the parrales supports used in Spain in the growing of the Almerian or so-called Malaga grapes.

It is only during recent years that any attention has been given to the pruning of Muscadine vines. In fact, the statement has frequently been made to the writers by the more intelligent and extensively interested growers that Muscadine vines can not be pruned without killing them.

Careful experiments have not only proved that Muscadines can stand pruning but that pruning is really necessary for the best results and to insure permanent and lasting vineyards.

During the last decade much attention has been given to a study of pruning and training methods by those interested in Muscadine grapes. Considerable has been accomplished, but much remains yet to be done to arrive at positive conclusions as to what are the best methods of pruning and the best systems of training.

The fact that some persons advocate no pruning, others moderate pruning, and still others severe pruning shows that results are obtained with Muscadines by all these methods. The safest plan is to take an



intermediate course and follow moderate pruning until it is proved that some other course is better.

Two systems of training are employed with Muscadine grapes: (1) The horizontal or overhead system (fig. 17), by which the growth is spread as an overhead canopy about 7 feet above the ground and supported by posts, and (2) the upright or vertical system (figs. 18 and 19), in which the growth is spread over a trellis. The prospective grower will need to determine which system is best for him, as this bulletin is only intended to point out the strong and weak points of both.

In the overhead system a single trunk is caused to grow erect from the ground alongside a permanent post. When the vine has reached



(P8749HP)

FIG. 17.—*Rotundifolia* vines trained in accordance with the horizontal or overhead system.

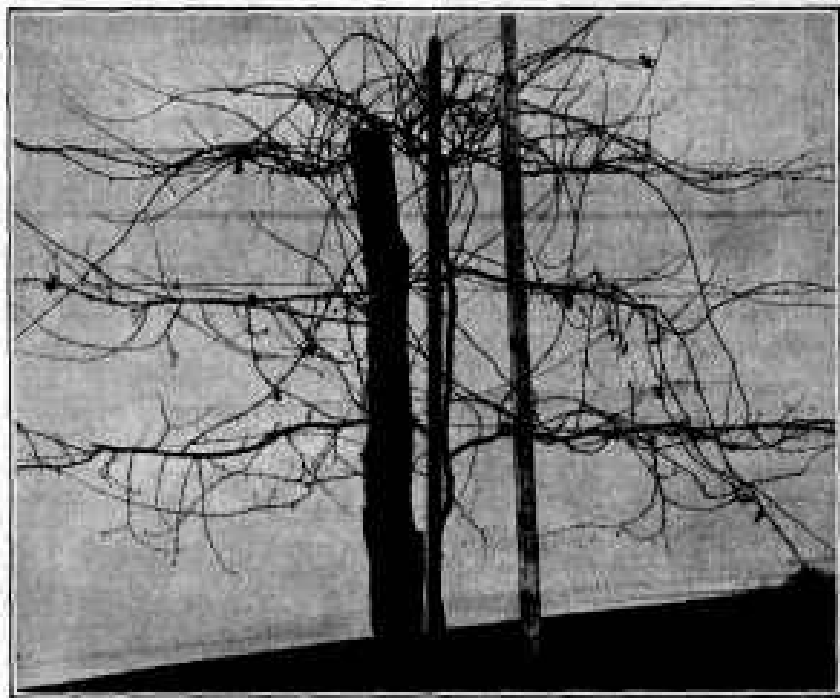
the top of the post it is pinched in or cut back, so as to make it throw out shoots to grow and spread out from the head of the vine as the spokes of a wheel radiate from the hub.

In the upright systems the fruiting arms are either radiated from a low vine head, like the ribs of a fan, or they are taken off as horizontal arms from a central vertical trunk (figs. 18 and 19).

Where the vineyard is not given close personal attention and pruning and other vineyard practices are neglected the best results will be obtained with the overhead trellis. Moreover, such a trellis permits cross-plowing and cultivation and is better adapted for grazing hogs, sheep, or cattle on cover crops grown in the vineyard. On the other hand, the careful vineyardist can expect the best and earliest results from vines on the upright or vertical supports. The upright

trellis facilitates pruning, harvesting, spraying, and intercropping throughout the life of the vineyard; it is also easier to repair and can be erected from \$10 to \$20 an acre cheaper than the overhead trellis. The use of both the upright system and the overhead trellis has netted the growers profitable returns. Each has its advantages and disadvantages. The prospective grower, knowing his own conditions, must determine which training system is best suited to his conditions.

During the first year after planting, a strong stake reaching 4 feet above the ground at each vine is sufficient support. A trellis should be erected the second season, though the upper wires of an upright



(P7864HP)

FIG. 18.—An unpruned *Rotundifolia* vine trained in accordance with the 6-arm renewal system.

trellis and the secondary wires of an overhead trellis may be added later, as the vines need them. In erecting an upright trellis the posts should be set midway between the vines, the distances apart varying with the distances between the plants. The end posts of the rows should be firmly braced. Three wires are generally used, placed 24, 42, and from 56 to 60 inches from the ground.

In erecting an overhead trellis, the usual method is to place a substantial, durable post reaching 7 feet above the ground at each of the permanent vines. Rows of extra-heavy, well-braced posts, running parallel with and also at the ends of the rows of vines, are

set at the boundaries of the vineyard. There are a number of different ways of arranging the wires. Usually No. 10 galvanized wires are securely fastened to the tops of the boundary posts on the four sides of a vineyard and then are run along and securely fastened on the tops of the inside posts down each row in both directions as governor wires. As needed, No. 14 wires 2 feet apart are run parallel with the governor wires until in this manner the entire area has been covered.

A cheaper but less durable overhead trellis is made by running No. 9 governor wires in only one direction and the secondary wires



(P12013HP)

FIG. 19.—An unpruned *Rotundifolia* vine trained in accordance with the radiating system.

only at right angles to the governor wires, the secondary wires being fastened to the governor wires wherever they cross.

Some growers construct arbors entirely of wood, using slats or poles instead of wires.

The pruning of Muscadine grapes during the first three years is mainly for the purpose of establishing the permanent parts and adjusting the other parts of the vine to the desired training system for future usefulness. After that the pruning is primarily a matter of renewing the bearing surface and keeping the vines healthy, vigorous, and productive.<sup>1</sup>

<sup>1</sup> For the objects gained in pruning and the principles underlying pruning, see the following publication, which may be had on application to the United States Department of Agriculture: Husmann, O.C., *Grape propagation, pruning, and training*. U. S. Dept. Agr., Farmers' Bul. 471, 29 p., 30 fig. 1911.

During the first season the trunk of the vine should be established. From this the main fruiting branches are started the second season. These, under favorable circumstances, will bear a small crop of fruit the third season. After that the purpose of pruning should be to renew growth, to increase or decrease the bearing surface, and to maintain the shape of the vine.

Severe pruning usually removes most of the fruit-bearing wood and throws the vine into vigorous wood growth. No pruning, on the other hand, causes a growth which is too much distributed, weak, and incapable of bearing good crops. Therefore, the grape grower should study the vines sufficiently to enable him to judge each year the proper severity of pruning for the best results. This will depend on the variety, the age of the vines, the fertility of the soil, etc. Muscadine grapes bear their fruit in small clusters. It is therefore necessary to maintain a large fruiting surface in order to secure a proper tonnage of fruit. This is accomplished by developing a series of fruiting arms, spurring along these, and lengthening them as the vines become stronger. Such fruiting arms can be maintained for a number of years, but after a time it is desirable to renew them. This is done by cutting out the arm and starting a new one from a cane that has been previously grown for such purposes. It is preferable to renew systematically only one or, at most, two arms on a vine each year. This gradual renewal does not disturb the vigor of the vine, but keeps it productive, healthy, and strong. The pruning can be quickly and easily done if systematically practiced from the time the vines are started.

Figure 12 shows the manner of pruning Muscadines when planting, while figure 20 shows them at the end of the second, third, and fifth years, trained to the horizontal or overhead system; figure 21, at the end of the second, third, and fifth years, trained to the vertical radiating system; and figure 22, at the end of the second, third, and fifth years, trained to the vertical 6-arm renewal system; while figure 17 shows an older unpruned vine on the horizontal overhead system; figure 18, an older unpruned vine on the vertical 6-arm renewal system; and figure 19, an older unpruned vine on the vertical radiating system.

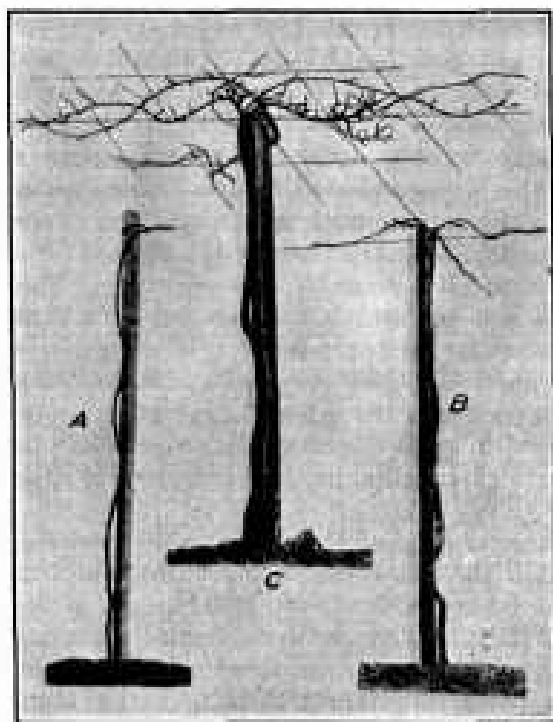
#### HARVESTING AND HANDLING.

When the fruit is intended for table use or shipping it should be hand picked. The varieties that do not shatter from the stem readily are the best for shipping. Such grapes should be carefully and attractively packed. The ordinary peach crate, strawberry crate, and 8-pound grape baskets are the containers generally used for such grapes. (Fig. 23.) The usual practice of harvesting Muscadine grapes for juice purposes is to jar them from the vines on to canvas or burlap sheets spread or carried under the vines. The

leaves, twigs, etc., accumulated with the fruit while jarring it from the vines are separated from it. This is usually done by running the mass through a fanning mill or by using a blowing apparatus. The jarred grapes are put into barrels and either hauled or shipped to the winery.

### YIELDS AND RETURNS.

No accurate records of yield have been kept in the older commercial vineyards, so little authentic information is available along that line.



(PLASSITT)

FIG. 20.—*Rotundifolia* vines trained in accordance with the horizontal or overhead system: *A*, End of second year; *B*, end of third year; *C*, end of fifth year.

The Scuppernong varieties, which are in greatest demand and for which the wineries pay the best prices, yield relatively small crops as compared to the James, Thomas, and other prolific sorts. An average yield of 25 to 30 bushels of Muscadine grapes per acre from 4-year-old vines, 50 to 75 bushels from 5-year-old vines, and 100 to 150 bushels from vines in full bearing should be obtained. Great variation in the yields occur, however. Inferior crops are caused by wet, cool weather at blooming time, late frosts, black-rot injury to bloom and foliage, weak old vines, lack of pruning, lack of fertilization, etc. Neverthe-

less, Muscadine grapes are considered among the most profitable of fruits. Large yields are often secured.

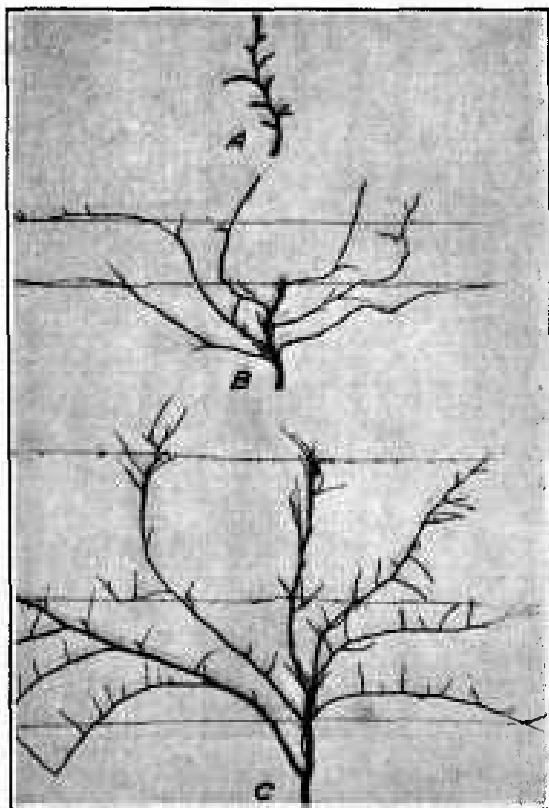
A Florida grower estimated his 1911 crop of Scuppernong and Thomas grapes at 280 bushels to the acre. The same year in eastern North Carolina a vineyard 77 years old, in which more than half the vines were Scuppernong, yielded 2.4 tons of fruit to the acre. The same season an adjacent Scuppernong and Mish vineyard about 20 years of age was said to have yielded 6 tons to the acre. In the same vicinity another grower secured from his James vineyard of 5.83 acres, 6.7 tons of fruit per acre, while his Scuppernong grape vineyard

of 5.86 acres yielded only 3.3 tons to the acre. In 1906 a North Carolina grower harvested 177 bushels of grapes to the acre from a 4-year-old James vineyard, and in addition a bale of cotton per acre was grown between the rows.

The price paid for Muscadine grapes varies somewhat with the seasons, the quality of fruit, the variety, and the condition of the market. In years of light fruit crops higher prices are paid. Hand-picked fruit of good quality, attractively packed, sells for more than similar grapes shattered from the vines. Generally, the light-colored varieties, being sought by the wineries, have sold for higher prices on the general market than the dark-colored grapes. In the past there has been considerable competition between wine makers for light-colored Muscadine grapes. In markets where the buyers of the companies were competing, such grapes have brought \$3 and even more per bushel. Nothing like such prices will probably ever be paid again. It has been possible up to the present time to contract with wine makers to take all the white Muscadine grapes the grower could produce for 75 cents or better per bushel for a period of years. The

average price paid for shattered grapes for the past six or eight years has been between 85 cents and \$1 a bushel. The prices paid for Muscadine table grapes are generally higher in the larger cities than in the villages or towns of the South, owing to the supply being relatively so much less in proportion to the population.

Choice hand-picked fruit in half-bushel peach baskets or in berry boxes usually sells for \$1 to \$2 a bushel. Certain growers have built



(P16833HP)

FIG. 21.—*Rotundifolia* vines trained in accordance with the vertical radiating system: A, End of second year; B, end of third year; C, end of fifth year.

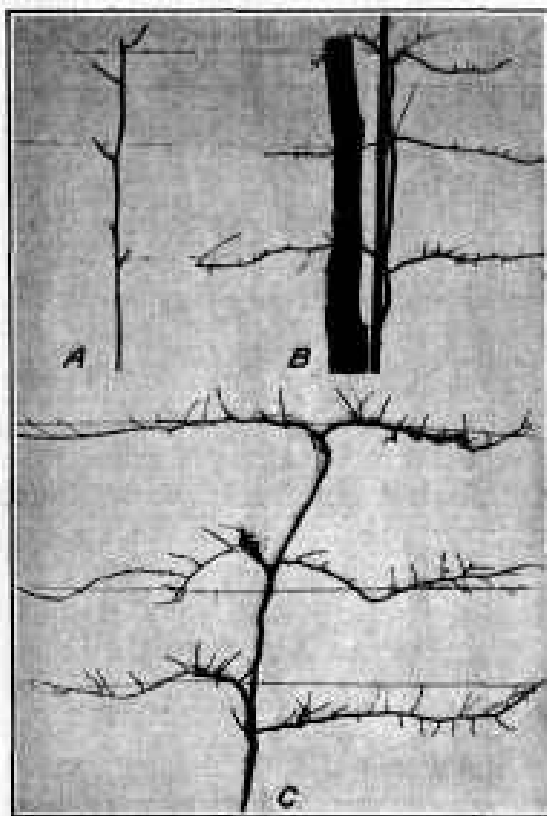
up an excellent trade for hand-picked fruit, sometimes shipping it to distant customers who are familiar with the Muscadine grapes. Under these conditions the fruit generally brings about \$2.50 per 6-basket peach crate. For such trade, of the varieties grown at present the James and Mish grapes are best suited. If sold locally, however, the Thomas and light-colored varieties are as valuable and are preferred by some customers.

#### USES OF MUSCADINE GRAPES.

Muscadine grapes are principally used for wine making. There are wineries in the South, the two largest that make a specialty of Muscadine products being located at Norfolk, Va., and Wilmington, N. C., respectively. These products are of characteristic flavor and quality and are in considerable demand. Probably three-fifths of the total Muscadine-grape crop is used by the wineries.

An unfermented juice for the home can be made from Muscadine grapes. Their unfermented juices, although quite pleasant when fresh as they run from the crusher, after sterilization appear devoid of fruity flavor. By adding sugar at the time they are used, the fruity flavor is largely restored. Unless better results than those so far obtained are to be had with them, they are not to be recommended as unfermented juices for commercial use.

As a table grape or as a fruit to be consumed fresh Muscadines are much relished, especially if eaten soon after they are picked from the vines. As most of the varieties shell from the comb when harvested, they are not generally adapted for shipping purposes. Their



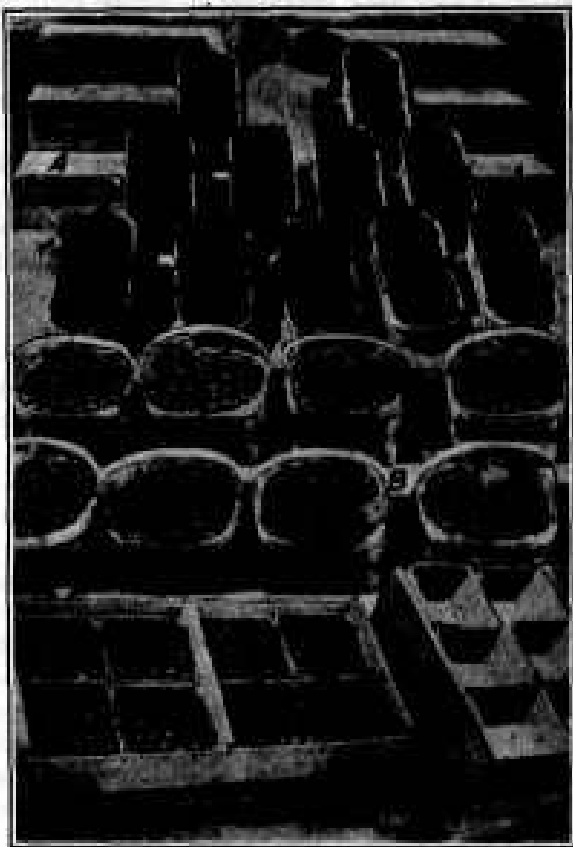
(P16830NP)

FIG. 22.—Rotundifolia vines trained in accordance with the vertical 6-arm renewal system: A, End of second year; B, end of third year; C, end of fifth year.

shipment for use as fresh fruit is an undeveloped phase of the industry. All Muscadine grapes make excellent jellies, preserves, catsup, etc. The canned grapes are used in pies.

#### INSECT ENEMIES AND DISEASES.

Muscadine grapes are generally considered remarkably free from insect enemies and diseases. There are, however, insects and diseases found on them which, while not serious at the present time, had best be noted and observed. The most important of the diseases is the black-rot (*Guignardia bidwellii*), which so generally attacks other grape species. This disease does not affect the fruit of Muscadine as it does Euvitis varieties, but it blights the bloom buds in unfavorable growing seasons. It affects the foliage of Muscadines, as it does of Euvitis vines, by causing brick-red diseased areas in which spore cases, resembling tiny black dots, may be noted. The remedy for this disease is to spray with Bordeaux mixture. Directions for spraying may be obtained from the United States Department of Agriculture. Insects worthy of note are the grapevine flea beetle (*Haltica chalybea*) and certain unidentified snout beetles, but the injury they do is at present negligible.



(P16092HP)

FIG. 23.—Hand-picked Muscadine grapes ready for shipment.

#### BREEDING INVESTIGATIONS.

The United States Department of Agriculture is conducting breeding investigations with Muscadine grapes for the purpose of producing varieties that are an improvement over present sorts in one or more



of the following particulars: (1) Better adherence of berry to cluster, (2) increased size of cluster, (3) higher sugar content, (4) lower acid content, (5) improvement in pulp, (6) decreased size and number of seeds, (7) thinner skin, (8) uniform ripening, (9) self-fertility.

A large number of valuable seedlings have been produced, to which additions are made each year. These are being tested and studied and the worthless ones discarded as rapidly as possible. Some exceedingly valuable sorts have already been secured. One lot of 49 seedlings has been produced in which over 50 per cent are perfect flowered and self-fertile, and there is not a sterile male seedling in the lot. It is believed that it is only a matter of time when self-fertile varieties with greater yields than the present varieties will be produced. With such varieties the planting of male vines will be unnecessary. Marked results are being obtained along other lines of breeding. A number of hybrids between Muscadine and American Euvitis and between Muscadine and Vinifera grapes have been produced, all of which are exceedingly promising.

#### VARIETIES.

It is not possible to give detailed descriptions of the Muscadine grape varieties in a bulletin of restricted size. Only general descriptions of the leading varieties will be given.<sup>1</sup>

#### SCUPPERNONG.

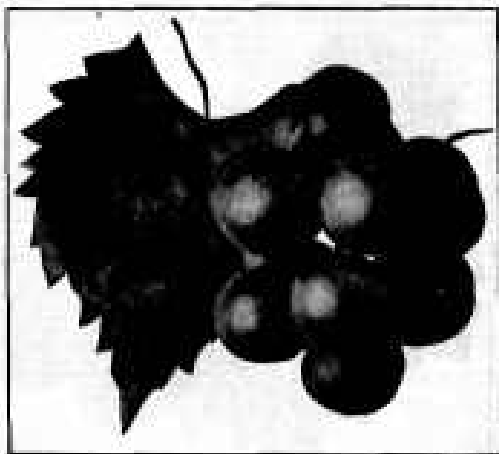
The Scuppernong is probably the oldest cultivated variety of native American grapes. While the place of origin can not positively be stated, owing to the age of the variety, it has been pretty definitely established that it originated in Tyrrell County, N. C., before 1760. From here it was soon distributed over the northeastern part of North Carolina and to Roanoke Island. In this section many large old Scuppernong vines are to be found. Many of these are known to be over 100 or 125 years of age. An old vine growing on Roanoke Island is said to have been planted by Sir Walter Raleigh and to be the original Scuppernong. Those who have investigated most closely the origin of the variety, however, adhere to the theory that the original vine grew wild in Tyrrell County, in the vicinity of the Scuppernong River.

From the vicinity of its origin the variety was distributed throughout the eastern part of North Carolina and was planted in vineyards ranging in size from a few vines to many acres. Some of these vineyards have been steadily enlarged, but many were allowed to run down. From these vineyards the variety was gradually distributed

<sup>1</sup> Those desiring detailed descriptions of the other known Muscadine varieties are referred to the following publication, which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 25 cents a copy: Rusmann, G. C., and Dearing, Charles, *The Muscadine grapes*. U. S. Dept. Agr., Bur. Plant Indus. Bul. 273, 64 p., 26 figs., 11 pl. (1 col.). 1913.

over the Coastal Plain and Piedmont sections of the southeastern United States. It has steadily increased in popularity and is to-day the leading variety of the Muscadine grapes.

The vine is productive and vigorous, a rank grower, with long, slender, smooth, yellowish canes, covered with small light-brown dots or lenticels. It thrives best in well-drained sandy loam soils. The leaves (fig. 24) are of medium size, cordate, with the margin medium serrate. In texture the leaf is smooth and rather thin in comparison with other varieties. The cluster is small, having 1 to 15 but generally 2 to 6 berries. The berries average three-fourths of an inch in diameter, and when fully ripe vary in color from pearly green to reddish brown, depending on the amount of exposure to the sun of the individual cluster and berry. They ripen fairly early and the individual berries shatter readily from the cluster when ripe. The skin of the berry is medium tough and is covered with numerous small russet dots, and sometimes russet blotches. The flesh is pale green, juicy, soft, musky, sweet, sprightly, and of good quality. The seeds are large. This variety is suited for home use and wine making. It is productive, but not so productive as the James or Thomas.



(P16828HP)

FIG. 24.—Leaf and cluster of the Scuppernong grape. (Two-thirds natural size.)

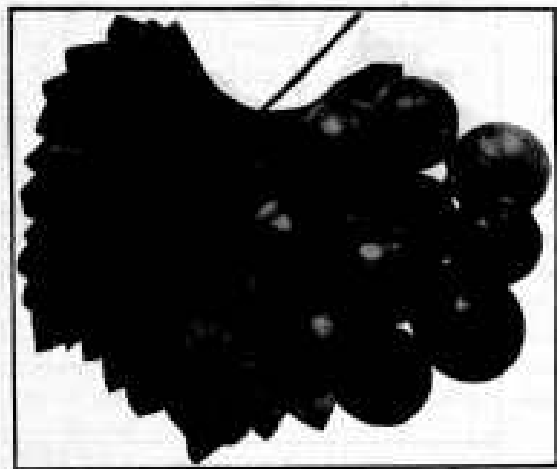
Some confusion has arisen in the past owing to the variety name, Scuppernong, having been rather loosely used. The leading Muscadine grape growers, wine makers, nurserymen, and horticulturists in the Muscadine grape district agree that the name should be applied to only the single variety of the Muscadine grapes which has just been described. The name Scuppernong is sometimes incorrectly used to designate other varieties having light-colored fruit, or all the varieties having light-colored fruit, or even all the varieties of Muscadine grapes, both light and dark. In the past, some nurserymen have sold other light-fruited varieties as the Scuppernong. Nevertheless, the variety should be kept distinct, and it is hoped that in the future nurserymen will assist in keeping it true to name by making sure that they propagate the true Scuppernong. Other light or dark fruited varieties have other names or should be given other names.

## MISH.

The Mish variety (fig. 25) was discovered by Mr. Albert Mish, between 1840 and 1850, growing in pure river sand near Washington, N. C. The vine is very productive and a vigorous, rather open, slightly trailing grower. The leaves are thick, rather round, and above medium size. The cluster is of medium size, the berries adhering fairly well to the pedicel. The berries range from about eleven-sixteenths to three-fourths of an inch in diameter, are slightly ovoid, almost black, and have numerous "guinea-egg" specks. The variety ripens uniformly but late. The skin is medium thin, cracking in wet weather. The flesh is tender, juicy, and sweet. The flavor is distinct, delicious, and of fine quality. The Mish is the best all-round Muscadino grape and is esteemed next best to the Scuppernong as a wine grape.

JAMES.

The James grape (fig. 26) was discovered about 1866 or 1867 by Mr. B. W. M. James, in Pitt County, N. C. It thrives in fine sandy loam soils with clay subsoil. The vine is very productive and a vigorous, slightly trailing grower. The leaves are cordate, nearly as broad as long, medium sized, with serrate margin; in late summer



(P1082711P)

FIG. 25.—Leaf and cluster of the Mish grape. (Two-thirds natural size.)

they have a mottled yellow and green appearance. The cluster is round, containing from 2 to 12, sometimes more, but usually 4 to 6, large, round, rather glossy, bluish or deep purplish black berries when fully ripe, with pronounced, not very numerous "guinea-egg" specks. The variety is rather late in ripening, and when not fully ripe there is a characteristic reddish coloring around the pedicel. The berry is juicy and the flesh meaty. The skin is thick and rather tough. The flavor and quality are medium. The James is the all-purpose grape of the Muscadines.

## FLOWERS.

The Flowers grape (fig. 27) was discovered by "Popping Billy" Flowers in 1819 growing in a sandy loam soil in Robeson County, N. C. The variety thrives in northern Florida and is said to do well as far south as the Florida keys. The vine is a very productive and

upright, slender, rather open, moderately robust grower. The leaves vary, but average medium in size, are longer than broad, pointed, cordate, thick, dark green, slick, and leathery, with the margin sharply serrate. The cluster is round, containing generally from 6 to 10 medium-sized purplish black, slightly oval berries. The Mish variety ripens late. The skin is very thick, tough, and faintly marked with dots. The flesh is white, meaty, tough, and not very juicy. The flavor is sweetish, lacks sprightliness, and is of medium quality.

#### THOMAS.

The Thomas grape (fig. 28) was discovered between 1850 and

1855 by Mr. Drewery Thomas, near Marion, S. C., growing in a fine sandy loam with fine clay subsoil. The vine is very productive and a vigorous, rank grower. The leaves are cordate, rather large, longer than broad, rather thick, with serrate margin. The variety ripens in



FIG. 28.—Leaf and cluster of the James grape. (Two-thirds natural size.)

midseason. The cluster is round and small. The berries are of medium size, round, and when fully ripe of a dark wine color, and surrounding the base is a wide, prominent, irregular, greenish yellow pentagonal marking. The berries ripen unevenly and have poor adherence to the pedicel. The flesh is tender, juicy, very sweet, and has an exceptionally rich, fruity, sprightly flavor. The skin is

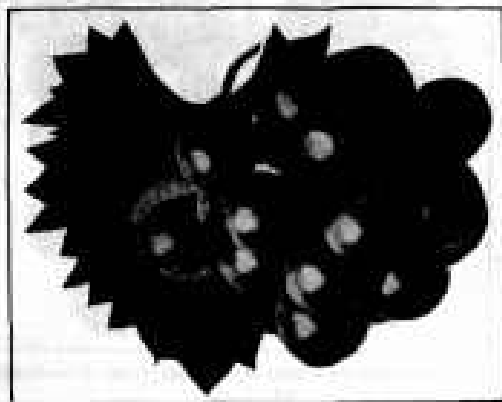


FIG. 27.—Leaf and cluster of the Flowers grape. (Two-thirds natural size.)

thin and moderately tough, with numerous pimples dotting the surface.

#### EDEN.

The Eden grape (fig. 29) was discovered on the premises of Dr. Guild, near Atlanta, Ga., growing in typical Piedmont red-clay soil. The

vine is exceedingly productive, vigorous, with dense foliage and dark-colored wood. The leaves are medium in size and thickness, rounded, with wide basal sinuses and rounded marginal teeth and blunt tip.

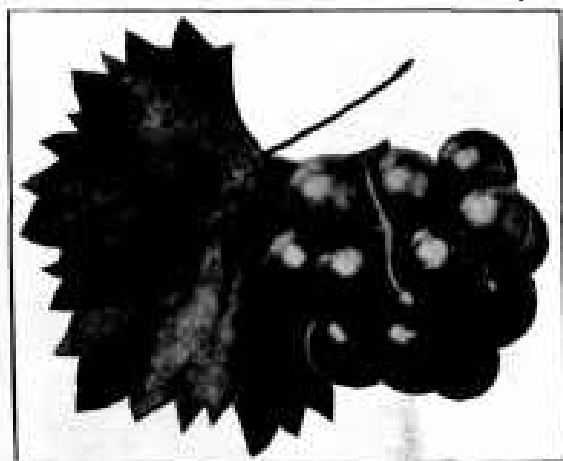


FIG. 28.—Leaf and cluster of the Thomas grape. (Two-thirds natural size.)

is very good. The skin is relatively thin and adapted for wine, home, and kitchen use. There are many points about the Eden suggesting that it is a natural hybrid between the *Rotundifolia* and *Munsoniana* species.

Other varieties of more or less prominence, named in the order of their estimated value, are the Smith, Memory, Luola, Hopkins, Latham, Lady James, Pee Dee, Sugar, Carolina Belle, Boula, Tenderpulp, Clayton, Westbrook, and Brown. A series of Muscadine grape hybrids produced by the late T. V. Munson is at present of interest chiefly to grape breeders.

#### CONCLUSION.

If, after reading this bulletin, the reader desires more specific information regarding some phase of Muscadine grape growing, the Department of Agriculture will be glad to furnish such information on application.

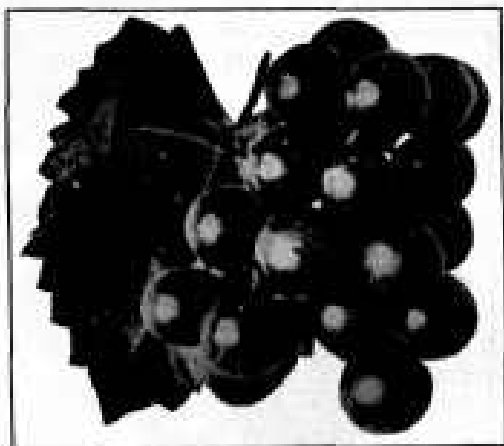


FIG. 29.—Leaf and cluster of the Eden grape. (Two-thirds natural size.)